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ABSTRACT

This report on information processing studies in Japan focuses on the installation and utilization of microcomputers at various educational levels, subject areas, and types of schools. Types of use explored include computer assisted instruction, computer managed instruction, and computer education. A brief description of the Japanese educational system and its current situation is followed by a presentation on how information processing studies are being carried out in schools with respect to form and content. The six-part paper comprises the following sections: (1) Education in Japan; (2) Curricula and Organization of the Teaching Content; (3) Information Processing Studies in Elementary, Lower Secondary, and Upper Secondary Schools; (4) Information Processing Studies in Universities; (5) Information Processing Studies in Special Training Schools; and (6) Information Processing Studies Outside the School. Numerous tables present sample curricula and statistics related to the discussion. (THC)

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INFORMATION PROCESSING STUDIES IN JAPAN

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INFORMATION PROCESSING STUDIES IN JAPAN

Section for Educational Cooperation in Asia
NATIONAL INSTITUTE FOR EDUCATIONAL RESEARCH OF JAPAN
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N O T E

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INTRODUCTION

The purpose of this paper is to offer an outline of information processing studies in Japan. A brief description of the Japanese educational system and its current situation is followed by a presentation of how information processing studies is being carried out in schools in respect of its form and content. The paper also refers not only to information processing studies carried out in schools and universities but also to those conducted by other organizations and enterprises.

I. EDUCATION IN JAPAN

Over the past century, education in Japan has been seen as involving more emphasis on school education than on education carried out in the home or in society. The pre-war education system was a "multi-track" system, which was replaced after the war by the present 6-3-3 "single track" system. Under this system, every citizen receives 9 years of compulsory education and is provided with equal educational opportunities in accordance with his or her ability.

In the Constitution of Japan, established in 1946, the fundamental rights and obligations of every citizen in respect of educational provisions are defined in the following way:

"All people shall have the right to receive an equal education correspondent to their ability, as provided for by law. The people shall be obligated to have all boys and girls under their protection receive ordinary education as provided for by law. Such compulsory education shall be free." (Article 26 of the Constitution)

The Fundamental Law of Education enacted in 1947 sets out in detail the objective and principles of education, in conformity with the spirit of the Constitution:

> "Education shall aim at the full development of personality, striving for the rearing of the people, sound in mind and body, who shall love truth and justice, esteem individual value, respect labour and have a deep sense of responsibility, and be imbued with the independent spirit, as builders of the peaceful state and society." (Article 1 of the Fundamental Law of Education)

In order to achieve this aim, the Fundamental Law of Education lays down definite nationwide principles with regard to equal educational opportunities, compulsory education, co-education, school education, out-of-school education, etc. The Fundamental Law of Education prohibits the schools established by law from carrying out political education in support of, or in opposition to, a particular political party, or national and public schools from teaching any specific religion, thus ensuring that education does not come under any form of improper control. With regard to equal educational opportunities for education, discrimination on grounds of race, faith, sex, social status, economic status or family background is forbidden in the Fundamental Law of Education.

Chart 1 on the next page shows the organization of the present school system in Japan. Educational institutions can be divided into the three

categories of national institutions founded by the State, public institutions founded by local public entities and private institutions founded by private organs (the school juridical person, etc.). A brief description follows the characteristics of each type of educational institution:

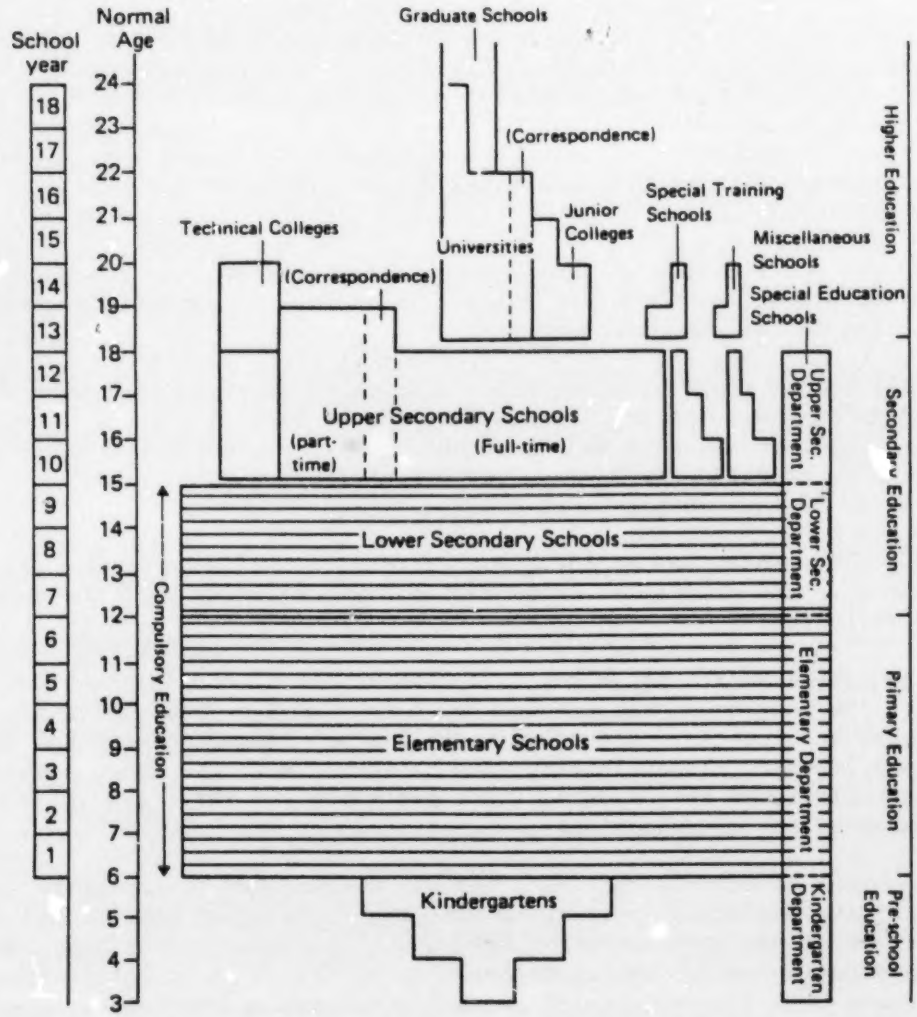

Chart 1 Organization of the School System of Japan

(1) Kindergarten and Day Nursery

In spite of the fact that pre-school education is not compulsory in Japan, as many as 90.0% of children of pre-school age go to a kindergarten or day nursery before going on to elementary school.

The objective of the kindergarten is to provide care for small children and to promote their mental and physical development by providing an appropriate environment. (Article 77 of the School Education Law) Infants between the age of 3 and 5 are admitted into kindergarten and receive between 1 and 3 years of pre-school education depending on the age when they enter kindergarten. The statistics for 1982 show that 59% of kindergartens are privately managed and that 74% of infants enrolled in kindergartens attend private institutions.

While kindergartens come under the jurisdiction of the Ministry of Education, Science and Culture and prefectural and local boards of education, day nurseries are administered by the Ministry of Health and Welfare and local welfare authorities, since they are regarded as child welfare facilities with "the aim of caring for infants whose parents and/or guardians are unable to do so." (Article 39 of the Child Welfare Law) The day nursery is primarily a caring institution for pre-school children who cannot be looked after at home either because both parents go out to work, because one or both parents are ill or because the child has only one parent. In this way, the day nursery differs from the kindergarten in its legal provisions, but, generally speaking, it is regarded as a pre-school facility similar to the kindergarten, so for children between the age of 3 and the age of entering elementary school the same education as that given in kindergartens is also made available in day nurseries.

(2) Elementary School

All children who have reached the age of 6 must enter a 6-year elementary school which has the task of "providing a general elementary education aimed at promoting the development of the pupil's mind and body". (Article 17 of the School Education Law) As of 1983, 99.3% of elementary schools are national or public schools established by the State or by the local boards of education, and the pupils attending these schools constitute 99.5% of the total number of elementary school pupils.

(3) Lower Secondary School

After completing six years of study at elementary school, all children must enter 3-year lower secondary schools that have "the aim of providing general education at lower secondary level continuing the development of mind and body on the basis of the foundation laid at elementary school". (Article 35 of the School Education Law) The nine years at elementary and lower secondary schools are designated as the compulsory education period and all Japanese citizens must be enrolled at lower secondary school until they reach the age of 15. As of 1982, 95% of all lower secondary schools are national or public schools and 97% of lower secondary school students attend these schools.

(4) Upper Secondary School

Those students who have completed three years of study at lower secondary

school may go on to upper secondary school which has "the aim of providing general and specialized education at upper secondary level continuing the development of mind and body on the basis of the foundation laid by lower secondary school education". (Article 41 of the School Education Law) In 1982, an average of 96.6% of lower secondary school leavers entered upper secondary schools and other educational training institutions.

In upper secondary schools, apart from the full-time course, there are also two other courses, namely, the part-time course where classes are given at night or at special times or periods, and the correspondence course. The number of years of study is 3 years for the full-time course and 4 years or more for the part-time course and the correspondence course. In 1982, there were 6,954 schools providing full-time courses (83.4% of the total number of schools), 1,379 schools offering part-time courses (16.5% of the total) and 12 schools offering correspondence courses (0.1% of the total). The number of students amounted to 4,457,045 for full-time courses (96.4% of the total number of students), 137,767 for part-time courses (3.0% of the total) and 25,974 for correspondence courses (0.6% of the total).

Upper secondary schools can be classified into those offering a general course and those offering specialized courses. The general course provides general education both for those students who wish to go on to institutions of higher education and for those intending to go into employment after leaving school.

The specialized courses offer vocational and other specialized education for those students who have selected particular professions as their future careers. The courses are further subdivided into homemaking, agriculture, industry, commerce, fisheries, nursing, science and mathematics, physical education and fine arts. In 1982, the total number of students excluding those in short-term courses,etc.,amounted to 4,594,812. Table 1 shows the percentages of the number of students by course. In the table, the row marked "Total" contains percentages of the students by course in relation to the total number of upper secondary school students and those rows marked "Male" and "Female" show the percentages of boys and girls in relation to the total number of students taking the particular course.

The overall ratio of male to famale upper secondary school students, 50.3% to 49.7%, shows no great imbalance. However, in the case of the specialized courses, more boys take courses in agriculture, industry and fisheries while more girls select commerce and homemaking.

Table 1 Upper Secondary School Students by Course (1982)

(%)

	General	Agri-culture	Industry	Commerce	Fisheries	Home-making	Others
Total	69.8	3.4	10.0	12.1	0.4	3.1	1.2
Male	48.7	68.2	96.2	30.3	89.2	2.0	28.2
Female	51.3	31.8	3.8	69.7	10.8	98.0	71.8

(5) Tertiary Education Institutions

There are 3 types of institutions of higher education, namely, university, junior college and technical college. In 1982, 36.9% (40.8% boys, 32.7% girls) of the age group went on to one or other of these institutions of higher education. And when students entering special training schools at higher education level and those enrolling in correspondence courses at university and junior college are included, the figure for those going on to tertiary education institutions rises to 49.6% (50.8% boys, 48.4% girls).

Table 2 shows the number of tertiary education institutions and students.

Table 2 Number of Tertiary Education Institutions and Students (1982)

		Status				Students (Thousands)	
		Total[1]	National	Public	Private	Male	Female
University	Institutions	455 (100)	95 (20.9)	34 (7.5)	326 (71.6)	-	-
	Students	1,818 (100)	425 (23.4)	53 (2.9)	1,340 (73.7)	1,413 (77.7)	405 (22.3)
Junior College	Institutions	526 (100)	36 (6.8)	51 (9.7)	439 (83.5)	-	-
	Students	374 (100)	16 (4.4)	20 (5.3)	338 (90.3)	38 (10.2)	336 (89.8)
Technical College	Institutions	62 (100)	54 (87.0)	4 (6.5)	4 (6.5)	-	-
	Students	47 (100)	40 (85.1)	4 (8.5)	3 (6.4)	46 (97.9)	1 (2.1)
Special Training School[2]	Institutions	2,804 (100)	189 (6.7)	159 (5.7)	2,456 (87.6)	-	-
	Students	479 (100)	17 (3.5)	22 (4.6)	440 (91.9)	180 (37.6)	299 (62.4)

Notes: 1) The figures in parentheses indicate percentages.

2) Those institutions at higher education level only.

1) University

In order to be admitted to university, it is necessary to have completed the course of studies at upper secondary school or be acknowledged as having scholastic ability equal or superior to someone who has done so, such ability to be measured by the "University Entrance Qualifying Examination" given by the Ministry of Education, Science and Culture. A bachelor's degree is awarded upon satisfactory completion of the 4-year course at university. In Japan, private universities constitute a substantial proportion of institutions of higher education and over three quarters of all university students are male.

A university can establish a postgraduate school for the purpose of carrying out advanced research in various academic fields. At postgraduate level, master's degrees and doctorates are awarded. The term of study for a master's degree is at least 2 years and for a doctorate a minimum of 5 years after receiving a bachelor's degree.

2) Junior College

Junior colleges are open to those who have completed upper secondary school; they offer 2- or 3-year courses in various subjects aimed at developing practical abilities for use in a range of professions or in everyday society. The proportion of private junior colleges is also large and an overwhelmingly large percentage, approximately 90% of all students, are female.

3) Technical College

Technical colleges provide courses lasting 5 years and were newly developed in 1962 for lower secondary school leavers, with the aim of training engineers in specialized fields of industry, the mercantile marine, etc. The courses offered include navigation, mechanical engineering, electrical engineering, industrial chemistry, civil engineering, etc. Most technical colleges are national colleges and the majority of the students are male.

4) Special Training School

The special training school system was institutionalized in 1976, at which time there were 893 schools and 131,492 students. By 1980, there were 2,520 schools and 432,914 students, and by 1982, 2,804 schools and 478,934 students, thus showing rapid growth. The special training school offers 3 types or levels of courses: an "upper secondary course" for lower secondary school leavers, a "college course" for upper secondary school leavers, and an "ordinary course" which is not directed at students of any particular educational background and which mainly teaches home economics, culture and general education. For each course, there is a day school course and an evening school course. In 1982, the number of upper secondary courses was 1,112 (day school courses 934 = 84.0%), of college courses 5,149 (day school courses 4,019 = 78.1%), and of ordinary courses 882 (day school courses 467 = 52.9%); the number of students was 73,000 on upper secondary courses, 362,000 on college courses and 44,000 on ordinary courses. 75.6% of all the special training school students are enrolled on college courses and 62.0% (224,000) of these are female.

Of the total number of students enrolled on college courses, 116,000 (32.0%) of them are taking sub-courses related to industry and business practice and it is estimated that between 30,000 and 40,000 of these students are studying computer-related subjects.

(6) Other Schools

There are various facilities outside the regular school system that are legally permitted to call themselves "Miscellaneous Schools." These schools offer courses in various vocational and practical subjects such as dressmaking, cooking, bookkeeping, English and Japanese typing (including word-processing), health and hygiene, flower arrangement, tea ceremony, driving, etc. The number of such schools amounted to 4,867 in 1982, of which the majority were privately managed. The number of students registered amounted to 628,000, approximately half of whom were female. 108,000 students took driving courses and 204,000 attended preparatory schools; these two courses accounted for about half the total number of students.

II. CURRICULA AND ORGANIZATION OF THE TEACHING CONTENT

In Japan, the Ministry of Education, Science and Culture establishes a nationwide standard for school curricula, the prefectural and local boards of education establish their own prefectural or local standards in compliance with this national standard and the actual conditions of the area concerned, and each school organizes its own school curricula taking into account the national and local standards as well as the stages of development of the pupils and students.

The Ministry of Education, Science and Culture maintains the national standards for teaching content and, in order to ensure the universal spread of school education, establishes a national standard for school curricula. The Ministry thus makes decisions on the kinds of subjects and the number of school hours in conformity with the School Education Law and the Enforcement Regulations of the School Education Law.

At all levels of education in Japan, from kindergarten to postgraduate school, Japanese is used as the medium of instruction for all subjects, with the exception of special courses such as foreign languages. The textbooks used are written in Japanese, and it is very rare for books written in foreign languages to be used, with the exception of reference materials used at university undergraduate and postgraduate level.

(1) Curricula in Elementary, Lower Secondary and Upper Secondary Schools

The Ministry of Education, Science and Culture compiles Courses of Study for elementary, lower secondary and upper secondary schools. In compiling the courses of study, the Ministry consults the Curriculum Council, an advisory organ to the Minister made up of school principals, educationalists, university professors and representatives from various circles, and takes due account of the Council's advice before reaching a final decision. The Courses of Study include standards for curricula that are not covered in the Enforcement Regulations of the School Education Law and cover standards related to the content of each subject, objectives, the distribution of school hours, the total number of school hours per grade, and others. Textbooks can be used only if they have been written in accordance with these Courses of Study and authorized by the Ministry of Education, Science and Culture.

The Courses of Study contain details of the content and objectives of each subject either from a general viewpoint or from that of the State, so there might be certain parts which cannot be applied uniformly to all schools in a particular area. In the case of lower secondary school, for example, Paragraph 1, Chapter 1 General Provisions of the Course of Study stipulates that "Each school should formulate a proper curriculum in compliance with the provisions of the laws and regulations concerned and those indicated in this Chapter hereinafter, in order to accomplish the educational aim of well-balanced development of individual students as human beings, with full consideration for the actual conditions of the school and its locality, and for the students' level of mental and physical development and their individual characteristics." According to this provision, therefore, each school has to form its own curricula in conformity with the Course of Study while taking into account the needs of the area and the progress and experience of the students. With regard to the organization of the curricula, Paragraph 4 of the same General Provisions of the Course of Study stipulates that "If necessary, the school may add some other contents not indicated in the following chapters.

In this case, however, the objectives of each Subject and each Field for each grade and the objectives and contents of Moral Education and Special Activities prescribed in this Course of Study should not be neglected, nor should the burden be too heavy upon the students." As a result, the general pattern of elementary, lower and upper secondary education is, more or less, one of uniformity in respect of the range and content of the subjects established in the Courses of Study.

(2) Curricula in Schools other than Elementary, Lower Secondary and Upper Secondary Schools

The Ministry of Education, Science and Culture does not lay down any rules with regard to the designation or content of the subjects and curricula in schools other than elementary lower secondary and upper secondary schools. In the case of university, for example, "University Establishment Standards" have been formulated on the basis of the School Education Law and the Enforcement Regulations of the School Education Law, and these lay down criteria with regard to the facilities, organization, faculties and departments of the university and to the bachelor's degree as well as specifying minimum standards with regard to the establishment of a university, covering the structure of the university, qualifications of teaching staff, the number of days and hours of classes in a year required for the acquisition of credits, the area and floor space of the building according to the type of faculty, facilities and conditions necessary for graduation, etc.

However, the formation of curricula and the subjects to be taught are left to the discretion of each university. The relevant passage reads: "The subjects to be taught at university are divided by content into the categories of general education, foreign languages, health and physical education and specialized subjects." (Article 19, Chapter 6 of the University Establishment Standards), and "Each university is to provide subjects that it considers to be necessary." (Article 18 of the same). Therefore, information on information processing studies in Japanese universities or special training schools can be obtained by looking at the particular situation of each school or university.

II INFORMATION PROCESSING STUDIES IN ELEMENTARY, LOWER SECONDARY AND UPPER SECONDARY SCHOOLS

(1) Installation and Utilization of Microcomputers at Elementary, Lower Secondary and Upper Secondary Schools

The Audio-Visual Education Division of the Social Education Bureau of the Ministry of Education, Science and Culture conducted a survey on the installation and utilization of microcomputers as of January 1983 in elementary, lower secondary and upper secondary schools throughout the country. The following three forms of utilization were conceived for the purpose of the survey:

1) CAI (Computer Assisted Instruction) use

Fields in which the microcomputer is utilized to assist the students to understand what they are studying (e.g. math drills, presentation of geometric figures, etc.)

2) CMI (Computer Managed Instruction) use

Fields in which the microcomputer is utilized for the processing of educational information and the management of the school (e.g. processing of the students' records, processing of health data, retrieval of information, etc.).

3) Computer Education

This comprises education on how to use computers and covers education related to computers in "Mathematics II" at upper secondary school and the instruction of basic knowledge related to computers (including the "Microcomputer Class", etc.), but excludes instruction given in subject-areas or subjects such as "Information Processing I and II", "Information Technology I, II and III" and "Foundation of Industry" in vocational upper secondary schools. Table 3 illustrates the results of the survey.

As can be seen from this table, the greatest degree of utilization is for CMI, followed by club activities and CAI. A comparatively large number of elementary schools use computers for CAI. However, judging from the number of computers installed, it would seem that computers are most often used for simulation purposes such as the demonstration and presentation of teaching materials in class rather than for individual study by each student. With regard to CMI, the computer is most frequently utilized for the processing of students' records and for clerical work, and is not used very much in relation to the studies of the students.

The Courses of Study compiled by the Ministry of Education, Science and Culture do not contain any provision on information processing studies in elementary and lower secondary schools. This is one of the major reasons why there are very few elementary and lower secondary schools, as compared to upper secondary schools, that utilize microcomputers in computer education. There are 62 upper secondary schools each of which has 21 or more computers installed (2,231 upper secondary schools replied giving the number of computers installed; this number constitutes 94.1% of the total number of schools with computers installed). Of these 62 schools, 5 only have a general course, while the majority (46 schools) offer an industrial course either alone or with other courses, followed by the schools (14 schools) offering a business course alone or with other courses. This indicates that vocational upper secondary schools particularly those offering industry and business related courses, are making use of microcomputers for the purpose of information processing studies.

(2) Information Processing Studies within the Upper Secondary School Curricula

In December 1969, a proposal concerning the "Promotion of Information Processing Studies in Upper Secondary Schools" was submitted to the Minister of Education, Science and Culture, by one of his advisory organs, namely, the Science Education and Vocational Education Council. This was because the Council felt that, given the advent of the so-called information society, it was a matter of urgent necessity to promote education related to the processing of information in the light of the advancement of Japanese society

Table 3 Installation and Utilization of Microcomputers in Elementary, Lower Secondary and Upper Secondary Schools

Classification		Conditions of Installation				Areas of Utilization							
		Total Number of Schools	Number of Schools with Computers Installed	Percentage of Schools with Computers Installed	Average Number of Computers	CAI		CMI		Computer Education		Club Activities, etc.	
						Number of Schools	%	Number of Schools	%	Number of Schools	%	Number of Schools	%
Elementary Schools	Public	24,802	27	0.1	1.1	23	85.2	6	22.2	0	0.0	15	55.6
	Private	168	9	5.4	2.4	2	22.2	8	88.9	0	0.0	2	22.2
	Total	24,970	36	0.1	1.4	25	69.4	14	38.9	0	0.0	17	47.2
Lower Secondary Schools	Public	10,252	94	0.9	1.3	31	33.0	60	63.8	2	2.1	32	34.0
	Private	550	100	18.2	3.1	18	18.0	76	76.0	2	2.0	31	31.0
	Total	10,802	194	1.8	2.2	49	25.3	136	70.1	4	2.1	63	32.5
Upper Secondary Schools	Public	3,954	1,970	49.8	3.9	688	34.9	1,209	61.4	318	16.1	766	38.9
	Private	1,242	400	32.2	4.8	131	32.8	294	73.5	59	14.8	111	27.8
	Total	5,196	2,370	45.6	4.1	819	34.6	1,503	63.4	377	15.9	877	37.0

Notes:

1) "The Average Number of Computers" under "Conditions of Installation" refers to the average number of computers owned by the schools that have computers installed.

2) The percentage figures under "Areas of Utilization" refer to the percentage of schools with computers installed that use their computers for the area of utilization in question. If a computer is utilized in a number of areas within one school, its use will be counted separately with regard to each area.

and economy and the improvements in people's lives, and that, against this background, it was extremely important to promote this kind of education in upper secondary school.

This proposal defines the objectives of information processing studies in upper secondary school, and contains comprehensive suggestions concerning such matters as the enrichment of school curricula, the establishment of courses for the promotion of this type of education, the training and recruitment of teachers, the installation and maintenance of facilities and equipment, etc. With regard to the contents of a course, it was acknowledged that, although it was desirable that information processing studies be implemented in as many upper secondary schools as possible, due consideration must be given to the limitations of certain conditions such as facilities and equipment, expenses and staff. Thus it suggested that, for the present, a course that focussed on information processing be established and that information processing studies be carried out with this course as the centre. The proposal contained suggestions for the establishment of an information processing course within the business course and for an information technology course within the industrial course.

On the basis of this proposal, the Ministry of Education, Science and Culture has been devising a number of policies for the promotion of computer education in upper secondary schools. The first manifestation of such a policy concerned the improvement of the curricula. Then, in 1970 and 1978, the Course of Study for upper secondary schools was revised, and, on both occasions, reorganization of the subjects related to information processing was carried out. At present, "Information Technology I, II and III" and "Systems Technology" have been adopted in the industrial course while "Information Processing I and II" have been established in the business course.

The content of these subjects is shown in Table 4.

Table 4 Content of Subjects related to Information Processing in the Course of Study for Upper Secondary Schools

Information Technology I

1. Objectives

Understanding of the fundamentals of technology concerning computer programming, and the development of ability in practical application.

2. Content

(1) Fundamentals of programming
(2) Complex programmes
(3) File processing
(4) Operating systems

Information Technology II

1. Objectives

Understanding of the fundamentals of computer-related technology, telecommunications and control, and the development of ability in practical application.

2. Content

(1) Fundamentals of computer technology
(2) Fundamentals of data communication
(3) Fundamentals of control technology
(4) Conservation technologies

Information Technology III

1. Objectives

Acquisition of basic knowledge and technology concerned with programme design, and the ability to apply this skill to software development.

2. Content

(1) Programme design techniques
(2) Debugging techniques
(3) Outlines of software

Systems Technology

1. Objectives

Understanding of the fundamentals of technology concerning systems and the development of ability in practical application.

2. Content

(1) Structures of systems
(2) Systems analysis
(3) Systems design
(4) Models and simulations

Information Processing I

1. Objectives

Understanding of computers and their uses, as well as the development of basic information processing abilities through practical training on computers.

2. Content

(1) Contemporary society and computers
(2) Functions and composition of computers
(3) Data processing
(4) Fundamentals of programming

Information Processing II

1. Objectives

Acquisition of technology concerned with programming and systems design through practical training on computers, as well as the development of basic

ability in processing management information with regard to enterprises.

2. Content

(1) Enterprise management and information processing
(2) Programming of data processing
(3) Systems design of data processing
(4) Management information processing

With regard to "Information Processing" in the business course, it is obligatory that there should be practical training in the use of electronic calculators. With regard to the industrial course, it is stipulated in the Points for Special Consideration in Teaching that, "With regard to subjects related to information technology such as 'Information Technology I', practical training in the use of electronic calculators should be effectively integrated into the lessons." In this way, practical training in the use of electronic calculators is made compulsory in the subjects related to information processing. It should be noted that "Information Technology I" and "Information Processing I" are open not only to students specializing in information technology or in information processing but also to students studying other sub-courses within the industrial and business courses.

Other related subjects include "Foundation of Industry", "Electronic Technology I and II" and "Automatic Control" in the industrial course, and "Mathematics for Management" and "Computation Practice" in the business course. Tables 5 and 6 give examples of curricula for the sub-courses in information technology and information processing.

Table 5 An Example of the Curriculum for an Information Technology Course

Subject-areas	Subjects	Number of Credits of Each Grade			Total Number of Credits
		I	II	III	
Japanese Language	Japanese Language I	2	2	-	4
	Japanese Language II	-	-	2	2
Social Studies	Contemporary Society	-	2	2	4
Mathematics	Mathematics I	4	-	-	4
	Basic Analysis	-	2	2	4
Science	Science I	4	-	-	4
	Physics	-	2	2	4
Health and Physical Education	Physical Education	3	2	2	7
	Health Education	-	-	2	2
Art	Music I	-	-	-	-
	Fine Arts I	-	2	-	2
	Crafts Production I	-	-	-	-
	Calligraphy I	-	-	-	-

Table 5 (continued)

Subject-areas	Subjects	Number of Credits of Each Grade			Total Number of Credits
		I	II	III	
Foreign Languages	English I	2	2	2	6
Total Number of Credits for General Education		15	14	14	43
Industry	Fundamentals of Industry	4	-	-	4
	Practice	3	6	8	17
	Drawing	2	-	-	2
	Mathematical Sciences in Technology	2	2	2	6
	Information Technology I	4	2	-	6
	Information Technology II	-	4	2	6
	Information Technology III	-	-	-	-
	Systems Technology	-	-	-	-
	Electronics Technology I	-	2	4	6
	Automatic Control	-	-	-	-
Total Number of Credits for Specialized Education		15	16	16	47
Total Number of Credits for General and Specialized Education		30	30	30	90
Number of Credits for Special Activities		2	2	2	6
Grand Total Number of Credits		32	32	32	96

Table 6 An Example of the Curriculum for an Information Processing Course

Subject-areas	Subjects	Number of Credits of Each Grade			Total Number of Credits
		I	II	III	
Japanese Language	Japanese Language I	4	-	-	4
	Japanese Language II	-	4	-	4
Social Studies	Contemporary Society	2	2	-	4
	World History or Geography	-	-	4	4
Mathematics	Mathematics I	4	-	-	4
	Mathematics II	-	2	2	4
Science	Science I	4	-	-	4
Health and Physical Education	Health	-	-	2	2
	Physical Education	2	2	3	7

Table 6 (continued)

Subject-areas	Subjects	Number of Credits of Each Grade			Total Number of Credits
		I	II	III	
Art	Music I	-	-	-	-
	Fine Arts I	-	2	2	4
	Crafts Production I	-	-	-	-
	Calligraphy I	-	-	-	-
Foreign Languages	English I	4	2	-	6
	English II	-	4	4	8
Total Number of Credits for General Education		20	18	17	55
Business	Business Economics I	3	-	-	3
	Bookkeeping and Accounting I	3	-	-	3
	Computation Practice	2	2	-	4
	Information Processing I	2	2	-	4
	Comprehensive Practice	-	2	2	4
	Bookkeeping and Accounting II	-	4	-	4
	Information Processing II	-	2	5	7
	Business Laws and Regulations	-	-	3	3
	Others (optional)	-	-	3	3
Total Number of Credits for Specialized Education		10	12	13	35
Total Number of Credits for General and Specialized Education		30	30	30	90
Number of Credits for Special Activities		2	2	2	6
Grand Total Number of Credits		32	32	32	96

Among the subjects taught in general upper secondary schools, a section called "Computers and Flow Charts" in "Mathematics II" is dedicated to the study of the functions of computers, algorithms and flow charts, and is also designed to make the students capable of preparing programmes applicable to the functions of the computers to be used and obtaining results by actually using these programmes on computers. However, in practice no school actually teaches this section in its classes, since it is not included in the items covered by university entrance examinations, and also because of a lack of facilities and teaching staff. For this reason, information processing studies are in practice almost non-existent in general upper secondary schools.

(3) Preparation and Improvement of the Facilities and Equipment related to Information Processing Studies

Facilities and equipment for vocational education in lower secondary and upper secondary schools are subsidized out of the National Treasury on the basis of the Vocational Education Promotion Law enacted in 1951. The

subsidies are offered in such a manner that one-third to all of the expenditure needed to effect improvements to bring facilities and equipment up to the standard set by the Vocational Education Council is covered by the National Treasury. Likewise, with regard to information processing studies, the standards for facilities and equipment for the specialized courses were fixed in October 1970, revised in December 1976. Four items in respect of facilities and 79 items in respect of equipment are listed as the standards for information-related courses, and minimum specifications for what each school must possess are indicated in respect of every course. Important items are shown in Table 7. Among the items of equipment is one item with an indicated quantity of 23; 23 is enough if two students share one item, since the number of public upper secondary school students studying in one class at the same time is restricted to less than 45, according to the "Law concerning the Planned Establishment of, and the Standard of Fixed Number of Educational Personnel in, Public Upper Secondary Schools". Microcomputers were not yet in existence at the time these standards were set, thus they are not listed in the regulations; however, the subsidizable item "Calculator" has now been replaced by "Microcomputer", therefore schools are allowed to receive State subsidies for the purchase of up to 23 microcomputers. As of August 1983, 120 schools (the information technology sub-course of the industrial course plus the information processing sub-course of the business course) had received subsidies for the installation of computers. The sum of money spent on information-related courses as a State subsidy in the 1983-84 Fiscal Year amounted to approximately 122.5 million yen.

Table 7 Standards for Facilities and Equipment for Information Related Courses

(1) Facilities

Facilities	Floor space (m^2)
Programming practice room	200
Card punching practice room	200
Electronic computer practice room	200
General practice room	490

(2) Equipment

Items	Quantity
Programming implements	
Programme blackboard	4
Card punching apparatus	
Card puncher	23
Data processing apparatus	
Electronic computer system	1
Data converter	2
XY blotter	1
Data communication practice device	2
Tape splicer	3
Tape winder	5
Tape tracer	4
Calculating apparatus	
Calculator	23
Computer simulator	1
Typewriter	
Typewriter	45

The promotion of the provision of computers for joint use among upper secondary schools in each prefecture was suggested in the proposal concerned with the "Promotion of Information Processing Studies in Upper Secondary Schools", made in 1970. This proposal aimed to find a solution to the anticipated difficulties in distributing computers and teachers in charge of computer-related studies to each school by establishing the facilities for computers for joint use, since the Course of Study required practical training in computers for subjects such as Information Processing I. At the same time, such facilities were expected to be used for the in-service training of teachers in charge of information processing courses. Thus subsidies toward the establishment of information processing study centres were initiated by the Ministry of Education, Science and Culture in accordance with this proposal, and 36 centres were established with the help of State subsidies up to the 1982-83 Fiscal Year. In addition to these, there are 2 centres established individually by prefectures without State subsidies. Therefore, as of 1984, information processing study centres exist in 36 out of 47 prefectures in Japan.

As of May 1982, 627 industrial upper secondary schools, whose principals are all members of the All Japan Industrial Upper Secondary School Principals Association, possess approximately 4,000 computers in total; 3,500 of them are said to be microcomputers and the remaining 500 are either small or medium-sized computers. There have been no investigations on computers owned by business upper secondary schools. However, it is estimated that a similar number of units are established in such schools, so that a total of approximately 8,000 units are estimated to be in use for information processing studies at upper secondary schools in Japan.

(4) Preparation and In-Service Training of Teachers in charge of Information Processing Studies

In Japan, the training of teacher is carried out in universities and colleges in accordance with the standards laid down by the Ministry of Education, Science and Culture. It is necessary to acquire credits in subjects specified by the Ministry at universities or colleges in order to receive a teaching certificate. The teaching certificates are of two kinds: the 1st Class Regular Certificate and the 2nd Class Regular Certificate. Two-year college graduates are allowed to acquire the 2nd class regular teaching certificate entitling them to teach in elementary and lower secondary schools. However, only four-year university graduates with a bachelor's degree are permitted to hold a teaching certificate for upper secondary schools.

Teachers taking charge of information processing studies are required to possess a teaching certificate for the course they are taking charge of. A teaching certificate for the subject-area labelled 'industry' is necessary for someone in charge of information processing in the industrial course, a teaching certificate for 'business' is required to teach information processing in the business course of vocational upper secondary schools, and a teaching certificate in mathematics is required to teach information processing in mathematics at general upper secondary schools.

In the proposal for the "Promotion of Information Processing Studies in Upper Secondary Schools" in 1970, it is stated, with reference to the preparation of teachers taking charge of information processing studies, that "Basically this issue will be left to universities. However, it may be

estimated that a considerable amount of time will be required until teachers needed are trained at the universities. Therefore, for the time being, there is a need to actively encourage the in-service training of leading teachers such as those in charge of the courses to be especially promoted in each prefecture". In response to this proposal, the Ministry of Education, Science and Culture has since 1970 been putting into effect the "Training Course for Teachers in charge of Information Processing Studies". The training period is 2 to 3 months. 909 teachers had taken this course by the 1983-84 academic year: in the beginning, over 100 teachers took this course each year, but for the past few years approximately 60 teachers took this course every year. Apart from the training courses organized by the State, there are also courses organized individually by prefectures at their information processing study centres. As a result, it can be said that teachers who are in charge of information processing studies in upper secondary schools at present either learned about this discipline at universities or were trained by means of in-service training courses.

IV. INFORMATION PROCESSING STUDIES IN UNIVERSITIES

(1) Basic Conception of the Promotion of Information Processing Studies

The production and installation of computers suddenly increased in the 1960s. As a result, the Ministry of Education, Science and Culture was requested to draw up urgent, long-term plans for general education in information processing in order to enable the people to adapt to a society every aspect of which is infiltrated by uses of the computer, as well as plans for professional training in information processing for researchers, educationalists, and specialists connected with computer systems and information processing. In response to this demand, the Ministry launched a Conference on Information Processing Studies in May 1969 and held a number of discussions. The deliberations were put together in May 1972 as the Basic Plan for the Promotion of Information Processing Studies. The definition of information processing studies was given in this basic plan in terms of the provision of "an education which aims to train and equip personnel with the necessary knowledge and ability to develop and manage computers with ease, as well as to cultivate the foundation of a positive attitude conducive to a proper understanding of computers and their use, in order to satisfy the social requirement that the computer, a major symbol and facet of civilization, be made use of to increase the sum of human happiness". The basic plan consists of two chapters: "The Significance and Objectives of Information Processing Studies" and "The Measures to be taken with regard to School Education at the present time", and the principal points are as follows:

1) General Information Processing Studies

General information processing studies aim to provide an education which will enable all students to recognize the possibilities and limits of information processing, and to adapt on their own will to the pattern of life in the information-oriented society of the future. Such subjects as introductory information science, introductory computer, value analysis and applied programming can be considered as part of a general education in information processing. Enough time should be allowed for the exercises in computer use which accompany the above-mentioned subjects. For that purpose, an information processing study centre, to be jointly used by all the departments of an institution, should be established and should take responsibility for

introductory education in information processing for all students as well as for the maintenance and management of the computer system in respect of educational use.

2) Professional Information Processing Studies and Information Science

Professional education and training in information processing aims to train experts and educational researchers who will take charge of the development of hardware and of the basic software system. New fields of study dealing with computers, such as information science, information engineering, computer science and computer engineering, make up the core of this education. Thorough consideration and planning are necessary for the establishment and implementation of a research system for this new field of study called information science which centres on the practical application of computers. The establishment of a professional course will be restricted to one course or so for each university for the time being. In establishing the professional course, it will be necessary: (1) to select according to strict criteria the universities capable of establishing and properly administering the professional course, (2) to make certain arrangements to prevent the weakening of such information science related courses as mathematical science, electronics engineering and business engineering, (3) to emphasize the desirability of requiring students to take not only the subjects in the professional course but also those in other courses, and (4) to limit the establishment of the professional course only to universities with a system able to ensure cooperative relationships between the professional course and other courses.

3) Educational Research System for Information Processing

The training of specialists in information processing is possible only where high-quality research in that field is carried out. Therefore, educational research activities in the field of information processing should be strongly promoted from all sides at graduate schools, research institutes and research facilities. The provision of a satisfactory number of suitable faculty members is currently an urgent requirement. If one thinks of information science as a wide-ranging area of study which extends over the traditional fields of the natural, human and social sciences, one could envisage the formation of an inter-departmental programme of educational research which would break down the traditional barriers between disciplines and departments. Special consideration would have to be given to ensuring enough time for computer use and to the disposition of young staff, both of which points are prerequisites for the success of the educational research system referred to above. Special consideration should also be given to assistance for private universities.

4) Teacher Training

In information processing studies, there is a particular need for teachers who are undergoing a continuous process of self-development and who have an investigative attitude, a thorough understanding of computer programming, and the ability to give lecture not by relying on the textbook but by reorganizing the contents to suit the particular circumstances. Since teachers in charge need a broader range of knowledge as well as the ability to foster a continuing investigative attitude on the part of students, teacher training should be carried out by universities. Also, an effective

procedure might be the provision of in-service training for the personnel in charge of information processing studies and research in universities and junior colleges, most of whom are young staff, by making maximum use of overseas study and domestic study leave systems, in order to solve as quickly as possible the shortage of educational researchers which constitutes a bottleneck in the promotion of information processing studies and in the development of information science in Japan. Regarding upgrading of the teachers at technical colleges and upper secondary schools, there is a need to respond to social demands for upgrading by holding various study meetings and in-service training courses in a systematic and effective manner.

(2) Professional Information Processing Studies

Professional departments concerned with information processing have existed within the Faculty of Science and the Faculty of Engineering since 1970. These departments are called by a variety of names such as the department of information engineering, department of information science, department of computer science, department of mathematical information engineering and department of information mathematical engineering. This variety of names is a result of the difference in emphasis in each university's research and educational system. Looked at from the point of view that information science is an interdisciplinary area, this variety can be considered as something desirable. (The above-mentioned information processing-related professional departments will hereinafter be called "Department of Information" in this paper, for the sake of convenience.) Education related to information processing is widely practised, with a relatively heavy emphasis put on it, within departments other than those mentioned above, such as metrology, control engineering, and within departments having to do with electrical matters, also in departments in the faculties of economy, business and commerce; however, the actual details are unknown due to the lack of concrete statistical data.

There are 28 departments of information in national universities, 6 departments in private universities, totalling 34 departments in all, and approximately 1,400 students as of 1982. As to graduate schools, 460 students are enrolled in master's courses in 35 universities and 110 students are in doctoral courses in 15 universities. The number of the departments of information and the number of students on undergraduate, master's and doctoral courses is shown in table 8.

Medium-sized computer systems are installed in each university as computers for exclusive use of the department of information, allowing the students to spend enough time with computers.

Table 8 Number of the Departments of Information and Number of the Students

Level \ Year		1970		1976		1982	
		a	b	a	b	a	b
Undergraduate course	National	5	235	23	765	28	1,005
	Private	2	120	6	415	6	415
	Total	7	355	29	1,180	34	1,420
Master's course	National	-	-	15	242	32	426
	Private	-	-	1	8	3	34
	Total	-	-	16	250	35	460
Doctoral course	National	-	-	10	79	12	89
	Private	-	-	1	4	3	21
	Total	-	-	11	83	15	110

Notes: a - Number of universities b - Number of students

In 1980, Ariyama carried out an investigation on the curriculum of 21 departments of information about their common features and the characteristics of each department. Since the names of the professional subjects available are so diverse, the professional subjects were classified by content, and the number of departments of information where the particular subject is given and the number of departments of information where the same or similar content of that particular subject is given in other professional subjects with different subject names were summed up for 28 typical professional subjects. The results are shown in Table 9. Ariyama classified the professional subjects into 7 fields: mathematical fundamentals, theory, application, software, hardware, electronics-telecommunication, systems-management engineering, and other related subjects. Then he analyzed which field was emphasized by each department of information and obtained 5 types. That is, (1) mathematics/science-fundamental theory-oriented type, (2) electronics-oriented type, (3) hardware-oriented type, (4) software-oriented type, and (5) information system-oriented type. He also computed the proportion of time taken up by experiments and practice in relation to the total teaching hours, namely, 31.5% maximum, 9.3% minimum, 16.4% in average, and found a concentration around the average value. Finally, he concluded that departments of information in Japanese universities are considerably affected by the computer science curricula prepared by the Association of Computer Machinery (ACM) in 1968.

Table 9 Names and Numbers of the Professional Subjects commonly available in most Departments among 21 Departments of Information [1]

Name of Subject or Content	A[2]		B[3]	
	Required	Elective	Required	Elective
Mathematical Fundamental				
Information mathematics, computer mathematics, dispersion-related mathematics, graph theory, etc.	10	3	-	1
Value analysis, numerical value calculation method	7	10	-	-
Theory				
Information theory	2	14	2	1
Automaton theory	-	6	-	3
Automaton and language theory	1	4	-	1
Language theory	-	4	-	2
Algorithm	-	2	-	3
Application				
Artificial intelligence	-	2	-	2
Form processing, pattern recognition, etc.	-	7	-	1
Software				
Introductory programming, introduction to algorithms, etc.	4	3	-	-
Programming language	6	10	-	-
Compiler structure theory	-	5	-	2
Operating system, etc.	5	1	-	-

Table 9 (continued)

Name of Subject or Content	A[2]		B[3]	
	Required	Elective	Required	Elective
Systems programme, programming systems, etc.	3	8	-	1
Data structure	2	5	-	4
Data base	-	1	-	-
Software engineering	-	2	-	4
Hardware				
Introduction to electronic computers	3	5	1	-
Logic circuits, digital circuits, logic design, etc.	7	7	-	1
Computer systems, computer structure, etc.	3	11	-	3
Data transmission, information transmission	2	8	-	3
Electronics, electronic circuits, etc.	10	7	-	1
Control engineering, etc.	5	10	2	-
Electronics-telecommunication				
Introduction to information engineering, etc.	5	10	2	-
Systems-management engineering				
Systems engineering	2	9	-	-
Planning mathematics	-	6	1	-
Operations research	-	6	1	-
Simulation	-	5	-	-

Notes: 1) Masataka Ariyama, Content Analysis of the Curricula of the Department of Information, bit, Vol. 12, No. 15, 1980.

2) A - Number of departments of information where the subject is given.

3) B - Number of departments of information where the same or similar content of the subject is given under the different subject names.

(3) Information Processing Study Centres and General Education in Information Processing

An information processing study centre, an educational facility for joint use within the university, was established in the University of Tokyo in 1972 as a place providing a "general education having the aim of developing the ability to understand computers and a readiness to use them in a positive manner." This centre is equipped with a computer exclusively reserved for general information processing studies and works as an institution which both standardizes and practises general education in information processing for all faculties and departments in the university, working on the basis of cooperation between the staff attached to the centre and the staff of each faculty and department. Later on, information processing study centres were established in nine universities: Hokkaido University, Muroran University of Engineering, Tohoku University, Nagoya University, Nagoya University of Engineering, Kyoto University, Osaka University, Kyushu University, and Kyushu University of Engineering, making 10 universities in

total throughout the country as of 1983.

Some universities do not possess computers exclusively reserved for general education in information processing, but have comprehensive information processing centres where one large-sized computer system is used for research calculations in science and technology, office work connected with libraries and school registration management, as well as for general education in information processing. Examples of these universities are the University of Tsukuba established in 1974 and others such as Tokyo Institute of Technology, Kobe University and Okayama University; it can be anticipated that universities of this type will increase in the future.

Two types of centres and the general education in information processing practised in each of them are presented below, taking Tohoku University and the University of Tsukuba as examples:

1) General Education in Information Processing at Tohoku University

"Information Science", which aims to provide systematic and practical computer education, is offered as an elective general education subject to all the freshmen. When a student wishes to take this subject, the term in which it can be taken (spring or winter term) is specified according to the faculty to which he/she belongs, and two credits are given for attendance at a 15-week, 90-minute series of lectures and practical work.

In Japan, many universities divide the 4-year course of studies into a 2-year general study course and a 2-year professional study course, the courses being held on separate campuses. Tohoku University is one such example, and there the general study course and the professional study course are given in different places. The Tohoku University Information Processing Centre was established on the campus of the general study course in March 1982. 120 terminals are placed in the practice room in the centre, four satellite stations are located in the science-related faculties (engineering, science, agriculture, pharmacy) and 35, 23, 12 and 6 units of terminals are installed in the faculties of engineering, science, agriculture and pharmacy, respectively.

This system of education in information processing is called the Tohoku University Information Processing Study Support System. During classes, the instructor faces the students and lectures while manipulating the instructor's terminal. It is possible to show the display either on all 120 terminals or only on specific terminals. On the other hand, while students are manipulating the terminals, the instructor can monitor the display of a specific student and display this on the instructor's terminal, send messages to specific students, or interrupt the manipulation. During the exercises, when students raise their hands to ask a question, the instructors in charge or graduate student assistants come to the students' desk and answer their questions or help their manipulation.

This course was held for the first time in 1980. For the first two years, the information processing study centre was not established, and students had to go for practice to the computer centre on the campus where the professional study course was held, an approximately 20-minute walk on a slope from the general study course campus. However, 800 students in 1980 and 1,300 students in 1981 enrolled in this course. In 1982, after the

establishment of the information processing study centre, two "Information Science" classes for students in literature courses and 14 classes for those in science courses were started, and approximately 1,700 students took the classes. In 1983, there was a total of 21 classes, namely, 6 classes for literature courses and 15 classes for the science courses; just under 2,000 students took these classes. This number represents approximately 90% of all university freshmen.

2) General Education in Information Processing at the University of Tsukuba

The University of Tsukuba is a new type of national university founded in 1973. Universities in the past used to be divided into narrow specialist fields, stagnant in both research and education, fixed in their ways, inflexible, and isolated from the society around them. The University is an university based on a new conception, open to society, aiming to promote new forms of research and education, strongly international in character, always ready to respond to the changing needs of modern society, and full of diversity and flexibility. With this background, this university differs in many respects with regard both to administration and educational research from other universities, and can be considered as unique in Japan.

The University is composed of three Cluster Colleges (from First to Third) and three Professional Schools, the capacity of one grade being approximately 1,500 students. The First Cluster of Colleges deals with studies bearing relation to humanities, physical sciences and social sciences, the Second Cluster of Colleges with studies related to life science and the study of human beings, the Third Cluster of Colleges with studies related to information sciences and engineering, including international relations and social engineering. The three Professional Schools are the School of Medicine, the School of Art and Design and the School of Physical Education.

The University has, as its philosophy, the principle that the mission of a university is to equip students with the necessary knowledge, skills and attitudes to enable them to fulfil their role as the future leaders of society. It also acknowledges the truth of such current descriptions of today as an information-oriented era or an information-oriented society, and recognizes that students must work as the leaders or supporting pillars of this society, after graduation. As a result, "Information Processing" (two credits) has been made a required course for all freshmen regardless of their majors: the credits given for this course are a prerequisite to becoming a junior. (Another required course for all students is "National Language" which aims at the acquisition of techniques whereby students can express their own thoughts accurately; this is equivalent to the American "Theme Writing" course.)

"Information Processing" has been available since 1974 when the first students entered the university, and approximately 13,000 students had completed this course as of March 1984. The University adopts a 3-term system, and each term comprises 11 weeks including one week for examinations. One class period is 75 minutes, and students gain two credits when they attend one lecture period, one seminar period and one practice work period every week for 10 weeks, submit the required papers and pass the examinations.

The lecture class is called "Introduction to Information Processing", and its objectives are defined in the course outline as follows: "The course aims to give students an understanding of the fundamental concepts of calculators and the position that calculators occupy within the society. Methods of expression of information structures, composition and motion theory of calculators, limits of abilities, the higher-class languages, software and examples of application will be explained." As can be seen from the above-stated, this course does not aim to provide instruction in computers and programming. It is an introductory course in information processing in a broad sense which not only helps students to gain a fundamental understandings of the computer itself, but also helps to develop appropriate viewpoints and ways of thinking in this information-oriented era on such problems as how computers are used for researches in the society, what dangers there are of the infringement of privacy accompanying computer applications, etc. The lectures are given by instructors who are using computers for their own researches, whose professional specialities are closely related to the technical fields of study of the students, and who possess a deep fund of general knowledge. For example, students of the School of Medicine receive lectures from professors of medicine, and students of the School of Physical Education from professors of physical education. The titles of the lectures and outlines of the contents covering 10 hours of classes are shown to each instructor in charge so that they can structure their classes in accordance with these.

Seminars and practice work assignments are supervised by instructors specializing in information sciences, and two instructors are assigned to one class of 40 to 50 students. Seminar classes and practice work classes are held in succession, and the objective here is to master methods of computer uses by means of the time sharing system (TSS). During the seminar period, students work chiefly on the grammar and related problems of FORTRAN, and during the practice work period, they learn about the manipulation of terminals, text editing and programme running. Some seminar classes are composed of lectures by instructors and discussions; however, some others are carried out by CAI. This CAI system is called MILESTONE (Microcomputer and Laser Video Disc-based Stand-alone/Online): it was developed by the University and is a system with extremely high performance functions, where each terminal is equipped with laser video discs for picture display. 45 terminal units are installed. This system can function either as an online-type or as a stand-alone-type CAI system, and can also be used as a TSS terminal. The ranges of FORTRAN grammar to be taught have different goals depending on the major of the students; however, the objective of this seminar and practice work is not perfect assimilation of the FORTRAN grammar, but experience in the methods of using computers through terminals in a conversational manner.

27 terminals are installed in the practice room so that two students share one terminal. The reason for two students sharing one terminal is that at the time when this course was opened in 1974, the cathode ray tube (CRT) displays were expensive and it was impossible to afford one terminal for each student. Nowadays it would be possible to prepare one terminal for each student; however, experience from the times when two students shared one terminal has shown that common ownership by two persons is rather more effective (small group effect) than each student having his/her own terminal in the area of general education on information processing. Regular CRT displays were used as terminals in the practice room until March 1983; however,

since April 1983, microcomputers have been introduced, which makes it possible to use them both online and offline. The reason for this is that, with the current popularity of microcomputers, learning of the BASIC language has been made possible. The terminals in the practice room and CAI terminals in the CAI room are freely open to the students at any time between 9 a.m. and 10 p.m., whenever not otherwise in use for classes.

V. INFORMATION PROCESSING STUDIES IN SPECIAL TRAINING SCHOOLS

Although there are no detailed statistics, as mentioned above, it has been estimated by the Association of Industrial Special Training Schools (part of the National Federation of Special Training and Miscellaneous Schools) that 30,000-40,000 students are currently receiving instruction in information processing in special training schools. The role which special training schools are playing in the training of personnel to be in charge of information processing in Japan can be considered as being extremely important, as shown by the fact that nearly all the students in industrial special training schools wish to find employment related to information processing and a considerable number of those involved in information processing activities within public agencies and private sectors are graduates from these industrial special training schools, also by the fact that special training school students constitute approximately two thirds of all students who passed the Second Category Information Processing Technician's Examination held by the Ministry of International Trade and Industry. Table 10 shows the number of information processing technicians who took the examination and who passed it in 1981, classified by examination category and the percentage of successful candidates, and Table 11 shows the number of successful candidates in the information processing technician's examination in 1981, classified by profession and given as actual numbers and as a percentage of all successful candidates.

Table 10 Number of Information Processing Technicians Who Took the Examination and Who Passed It, 1981

Examination Category	Number of Candidates	Number of Successful Candidates	Percentage of Successes
Special Category Information Processing Technician's Examination	3,877	422	11.4
First Category Information Processing Technician's Examination	11,440	1,327	11.6
Second Category Information Processing Technician's Examination	25,445	5,089	20.0

Table 11 Number of Successful Candidates in the Information Processing Technician's Examination, 1981

Profession	Special Category		First Category		Second Category		Total	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Electronic computer manufacturing and sales business	204	46.1	232	17.5	367	7.2	803	11.7
Software business	58	13.1	363	27.4	1,390	27.4	1,811	26.4
Calculation centres, etc.	81	18.3	273	20.6	871	17.1	1,225	17.9
General business firms and Associations	90	20.4	232	17.5	831	16.3	1,153	16.8
Public agencies	4	0.9	14	1.0	102	2.0	120	1.8
Schools and Research institutes	2	0.5	23	1.7	73	1.4	98	1.4
Private enterprises	0	0	0	0	2	0	2	0
Students	2	0.5	181	13.6	1,416	27.9	1,599	23.3
Others	1	0.2	9	0.7	37	0.7	47	0.7
Total	442	100.0	1,327	100.0	5,089	100.0	6,858	100.0

(1) Information Processing Technician's Examination

The Information Processing Technician's Examination tests "the knowledge and skills related to information processing possessed by those in charge of information processing-related activities for the purpose of their technical upgrading." (Law concerning Information Processing Promotion Enterprise Associations, Article 6) The examination was first held in 1970. Unlike other national examinations, it does not yield any qualifications or licenses, but it acknowledges the abilities and techniques possessed as an information processing technician as measured against a fixed standard; the names of those who succeed in passing this examination, which is held once a year, are published in the official gazette, and a Certificate of Success in the Information Processing Technician's Examination is issued to every one of them by the Minister of International Trade and Industry. The examination is divided into three categories, and has no age limitations except for the Special Category, where candidates must be aged 25 or older, and there are no restrictions whatsoever, whether from the point of view of academic background, sex, age or experience on anyone taking these examinations. The examination categories and the corresponding knowledge and skills to be possessed are shown in Table 12. This Information Processing Technician's Examination is highly respected in society: leading companies give priority in offers of employment to those who have passed this examination, or to those who already have jobs, offer special promotion when they pass it.

Table 12 Examination Category and the Corresponding Knowledge and Skills to be possessed by the Candidates

Examination Category	Target of the Examination	Standard
Special Category	Systems Engineer (engaged in the analysis and planning of information processing systems)	Person with more than 3 years of practical experience, possessing the knowledge and skills necessary for the planning of information processing systems
First Category	Senior Programmer	Person with more than 3 years of programming experience, possessing the knowledge and skills necessary for programming and the preparation of advanced programmes
Second Category	General Programmer	Person with more than 1 year of programming experience, possessing the knowledge and skills necessary for the preparation of programmes

(2) Curricula of Information Processing Studies in Special Training Schools

Departments for information processing studies established within the special training schools are called by various names: Departments of Information Processing, Information Technology, Electronic Computers, Electronic Information, Information Systems, Information Accounting, etc. Most of the schools where departments concerned with information processing studies have been established, have both one-year and two-year courses. One-year courses mostly centre around the basics of programming, giving the training required by machine-operators, i.e., the training of junior technicians, and the number of students is small. The core course is the two-year course, which aims to help the student acquire systematically a broad theoretical basis and technical skill as an information processing technician, and not as a mere programmer.

Curricula differ in degree of emphasis put on specific points, according to the departments' objectives. A course may, for example, be mainly hardware-oriented or mainly software-oriented. If it is software-oriented, it may be chiefly system software-oriented or chiefly application software-oriented. However, the differences are smaller than those between departments of a university or between universities, and curricula are relatively similar to each other. Because these schools aim to try and achieve the same or even a higher level of education than universities in a shorter period of time, most schools give more than 1,200 hours of classes every year, and a strict check is kept of attendance.

A typical example of a curriculum is shown in Table 13.

Table 13 Typical Curriculum of a Department of Information Processing in a Special Training School

Name of Subject	Number of School Hours
First Year	
Introduction to Computer Systems	100
Programming Language	80
Programming Exercise	80
COBOL Language - File System Exercise	80
FORTRAN Language Exercise	80
ASSEMBLY Language	60
ASSEMBLY Programming Exercise	20
Computer Organization Method Exercise	40
Microcomputer Organization Exercise	40
Value Analysis	80
Dispersion Mathematics	60
Technical English (English - Japanese Translation, English Composition)	60
Data Base Management System	40
System Programming	80
Computer Graphics	40
Computer Graphics Programming Exercise	40
Operating System Planning	40
Algorithm - Data Structure	60
Algorithm - Data Structure Exercise	60
Language Translator	40
Language Translator Exercise	40
Second Year	
Modular Programming Exercise	40
Structural Programming	20
Programming Language Planning	20
Modular Designing Technique	20
Peripheral Machinery of Computers	20
Micro Programming Exercise	40
High-Level Machine Language	20
Demand Engineering	40
Software Production Management Exercise	40
Software Testing Technique	20
Programme Inspection Method	40
Automaton Theory - Format Language	40
Graph Theory	20
Technical English	60
Operating System Design Exercise	60
Data Base Modeling Design Exercise	40
Computer Network - Distribution System	40
Computer Graphics Exercise	60
Graduation Study (Seminar) Exercise	560

VI INFORMATION PROCESSING STUDIES OUTSIDE THE SCHOOL EDUCATION

Two examples can be cited of information processing instruction given outside the framework of school education: lecture classes held by the computer manufacturing and sales companies for their users, and computer instruction given by the computer section for its staff or for other sections within various enterprises and agencies. The former type, sponsored by the computer manufacturing and sales companies, can be divided into a number of courses according to the levels and objectives of the learners, and there is considerable diversity in the number of learners and the term of the lectures. Usually, several courses are available simultaneously, generally for over 30 weeks per year. The courses constitute an important facet of learning for users, who are able to become proficient in specific machines through these lecture classes.

Because the number of people who have received professional information processing instruction in universities does not sufficiently meet the demand for information processing personnel in society, those with backgrounds in professional information processing studies are usually placed to research institutes or the development section of enterprises, and it is usual for new college graduates without a professional background in information processing to be employed and educated within the company. For example, there are approximately 30 members of staff in charge of information processing in the University of Tsukuba. However, of the 30 information processing staff, not one person has had previous experience of studying information processing at his/her university, and all of them received training in programming after joining of the University; this is in spite of the fact that the University has 2 departments, the Department of Information Engineering and the Department of Information Science, and that 160 undergraduate students and 20 master's course students graduate every year. In this way, education outside school occupies an important position in the training of personnel in information processing.

CONCLUSION

The term "Computer Literacy" is receiving considerable emphasis throughout the world, and even kindergartens are starting to educate children in it. But this is not the case in Japan, and almost no general education in relation to computer is offered to elementary and secondary school students. Education in information processing as part of general education, i.e., education for Computer Literacy can be seen only in a few universities.

At present, therefore, education in information processing in Japan exists within the framework of professional training. A special attention should be paid to the policy taken by the central government: to draw up a unified curriculum in order to respond to the social demand for information processing technicians; to issue subsidies for equipment and facilities required for information processing studies in order to maintain a set standard; in addition, from the viewpoint that research and education on information processing are of interdisciplinary, to actively promote the establishment of information processing-related departments only in such universities where information processing studies will be recognized as involving interdisciplinary research and education crossing traditional academic boundaries; and to maintain a set standard by furnishing these universities with the necessary computers and securing facilities for practice

by students.

A one-year domestic study programme for university teachers and 2-3 month in-service training courses for upper secondary school teachers have been started in order to secure teachers who can take charge of information processing studies. As a result of these active measures, it can be said that a supply of teachers of the required quality in the necessary numbers has been successfully secured.

Without the measures outlined above, it would never have been possible to respond to the social demand for specialists in information processing. However, it is necessary to emphasize strongly the significance a number of special training schools have had for the education of professionals in information processing, apart from the above-mentioned educational measures. The goals of education of universities and special training schools differ; since special training schools offer education concentrated on the aim of training people ready to offer immediate services to society, they play a more important role than universities in the training of professional technicians who will assume responsibility for information processing activities.

Mention should also be made of the education in information processing conducted within companies and enterprises. Education within companies is fairly popular because of the lack of supply from schools and universities, and because the quality of training given by educational institutions is lower than expected by the companies, and also because of the necessity to habituate employees to the company's own type of computer and its know-how; most of the information processing technicians actively at work in companies have been trained within the companies. In this way, companies and enterprises do not necessarily expect education in information processing to be given in school, but plan to train and secure the necessary personnel through their own efforts. This fact may be considered to be the reason why the term Computer Literacy is not talked about extensively in Japan.

Information processing studies in Japan are conducted in a variety of forms as described above and as a result meet various social demands for information processing technicians.